

Time: 110 minutes

Chemistry 101

June 18, 1999

R. Sultan

Final Exam

Name: _____

Student Number: _____

Useful Information

- There are 50 multiple-choice type questions, and only ONE of the proposed answers is correct. Circle the letter corresponding to the right answer.
- Tables of atomic numbers and molar masses of the elements and periodic tables provided.
- Table of electronegativities attached.

Physical constants and Conversion factors

- Avogadro's number: $6.023 \times 10^{23} \text{ mol}^{-1}$
- Gas constant: $R = 0.08206 \text{ L atm/mol K}$
- Planck's constant: $h = 6.626 \times 10^{-34} \text{ Js}$
- Speed of light: $c = 2.998 \times 10^8 \text{ ms}^{-1}$
- Rydberg's constant: $R_H = 2.18 \times 10^{-18} \text{ J}$
- $1 \text{ nm} = 10^{-9} \text{ m}$

Good Luck

- The name of the compound CrO_3 is:

- Chromium oxide
- Chromium (II) oxide
- Chromium (III) trioxide
- Chromium (III) oxide
- Chromium (VI) oxide

- What is the theoretical yield of vanadium that can be produced by the reaction of 40.0 g of V_2O_5 with 40.0 g of calcium according to the following equation?



- 11.2 g
- 20.3 g
- 22.4 g
- 40.0 g
- 5.6 g

- An atom of bromine has a mass about four times greater than that of an atom of neon. Which choice makes the correct comparison of the relative numbers of bromine and neon atoms in 1,000g of each element?

- The number of bromine and neon atoms is the same.
- There are one thousand times as many bromine atoms as neon atoms.
- There are one thousand times as many neon atoms as bromine atoms.
- There are four times as many neon atoms as bromine atoms.
- There are four times as many bromine atoms as neon atoms.

- The mass of 1.63×10^{21} silicon atoms is:

- 2.71×10^{-23} g
- 4.58×10^{22} g
- 28.08 g
- 1.04×10^4 g
- 7.60×10^{-2} g

- How many sodium atoms are in 6.0 g of Na_3N ?

- 3.6×10^{24} atoms
- 4.6×10^{22} atoms
- 1.3×10^{23} atoms
- 0.217 atoms
- 0.072 atoms

- Balance the following equation, then add together the coefficients. Don't forget to count coefficients of one. The sum of the coefficients is:



- a. 4
- b. 6
- c. 7
- d. 9
- e. none of these.

- How many protons and electrons are present in a Br^- ion?

- a. 35 p, 35 e
- b. 80 p, 81 e
- c. 35 p, 34 e
- d. 35 p, 36 e
- e. 80 p, 34 e

- Which pair of elements would be most likely to form an ionic compound?

- a. P and Br
- b. Zn and K
- c. F and Al
- d. C and S
- e. Al and Rb

- What is the formula for the simple ionic compound formed by magnesium and iodine?

- a. MgI
- b. Mg_2I
- c. MgI_2
- d. MgI_3
- e. Mg_3I

- When J. J. Thomson discovered the electron, what physical property of the electron did he measure?

- a. Its charge, e
- b. Its charge-to-mass ratio, e/m
- c. Its temperature, T
- d. Its mass, m
- e. Its atomic number, Z

- Which of the following indicates the presence of weak intermolecular forces in a liquid?

- a. A low heat of vaporization.
- b. A high critical temperature.
- c. A low vapor pressure.
- d. A high boiling point.
- e. None of the above.

- Helium atoms do not combine to form He_2 molecules, yet He atoms do attract one another weakly through

- a. Dipole-dipole forces.
- b. Ion-dipole forces.
- c. Dispersion forces.
- d. Dipole-induced dipole forces.
- e. Hydrogen bonding.

- Which one of the following molecules has a dipole moment?

- a. BeCl_2
- b. Br_2
- c. BF_3
- d. IBr
- e. CO_2

- Which one of the following is a polar molecule?

- a. PBr_5
- b. CCl_4
- c. BrF_5
- d. XeF_2
- e. XeF_4

- Which one of the following molecules is nonpolar?

- a. NH_3
- b. OF_2
- c. CH_3Cl
- d. H_2O
- e. BeCl_2

- Complete this sentence: The PCl_5 molecule has:
 - Nonpolar bonds, and is a nonpolar molecule.
 - Nonpolar bonds, but is a polar molecule.
 - Polar bonds, and is a polar molecule.
 - Polar bonds, but is a nonpolar molecule.
 - None of the above.

- The $\text{F} - \text{S} - \text{F}$ bond angles in SF_6 are:
 - 90°
 - 109.5°
 - 120°
 - 180°
 - 90° and 120°
 - a) and d)

- The geometry of the ClF_3 molecule is best described as:
 - Distorted tetrahedron.
 - Trigonal planar.
 - Tetrahedral.
 - T-shaped
 - Trigonal pyramidal

- According to the VSEPR theory, the shape of the SO_3 molecule is:
 - Pyramidal.
 - Tetrahedral.
 - Trigonal planar.
 - Distorted tetrahedron.
 - Square planar.

- Use VSEPR theory to predict the shape of the PCl_3 molecule.
 - Linear.
 - Bent.
 - Trigonal planar.
 - Trigonal pyramid.
 - Tetrahedral.

- According to the VSEPR theory, the F — As — F bond angles in the AsF_4^- ion are predicted to be:
 - a. 109.5°
 - b. 90° and 120°
 - c. 180°
 - d. $< 109.5^\circ$
 - e. $< 90^\circ$ & $< 120^\circ$

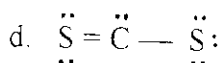
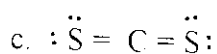
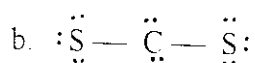
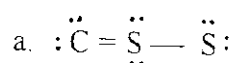
- The formal charge on the bromine atom in BrO_3^- drawn with three single bonds is:
 - a. -2
 - b. -1
 - c. 0
 - d. +1
 - e. +2

- The formal charge on the sulfur atom in the resonance structure of SO_2 which has one single bond and one double bond is:
 - a. 0
 - b. +1
 - c. -1
 - d. +2
 - e. -2

- Each of the three resonance structures of NO_3^- has how many lone-pairs of electrons?
 - a. 7
 - b. 8
 - c. 9
 - d. 10
 - e. 13

- The Lewis structure for chlorate ion, ClO_3^- should show _____ single bond(s), _____ double bond(s), and _____ lone pair(s).
 - a. 2, 1, 10
 - b. 3, 0, 9
 - c. 2, 1, 8
 - d. 3, 0, 10
 - e. 2, 1, 10

- The Lewis structure for CS₂ is:



- Which bond has the greatest polarity (highest percent ionic character)?

- Si — P
- Si — S
- Si — Se
- Si — Cl
- Si — I

- Which one of the following is a polar covalent bond?

- Cl — Cl
- Si — Si
- Ca — Cl
- Cr — Br
- P — Cl

- Which one of the following ionic solids would have the largest lattice energy?

- NaCl
- NaF
- CaBr₂
- CsI
- CaCl₂

- Which of the following elements has the greatest metallic character?

- Ca
- Mg
- Ba
- As
- Se

- Which element will display an unusually large jump in ionization energy values between I_3 and I_4 , the third and fourth ionization energies?

- Na
- Mg
- Al
- Si
- P

- Which element has the greatest atomic radius?

- B
- Al
- S
- P
- Si

- Arrange the following ions in order of increasing size, K^+ , P^{3-} , S^{2-} , Cl^- .

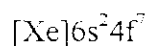
Increasing radius \longrightarrow

- K^+ , Cl^- , S^{2-} , P^{3-}
- K^+ , P^{3-} , S^{2-} , Cl^-
- P^{3-} , S^{2-} , Cl^- , K^+
- Cl^- , S^{2-} , P^{3-} , K^+
- Cl^- , S^{2-} , K^+ , P^{3-}

- Which of the following is the electron configuration of the Fe^{3+} ion?

- $[Ar]3d^5$
- $[Ar]4s^13d^5$
- $[Ar]4s^23d^3$
- $[Ar]3d^6$
- $[Ar]4s^23d^9$

- Consider an element with the following electron configuration. How would you classify this element?



- A representative element.
- A lanthanide element.
- A nonmetal.
- An actinide element.
- A noble gas.

- Mendeleev proposed the existence of an unknown element that he called eka-aluminum. This element is now called :

- a. Magnesium.
- b. Silicon.
- c. Gallium.
- d. Boron.
- e. Germanium

- According to the solubility rules, which one of the following is soluble in water?

- / a. $(\text{NH}_4)_3\text{PO}_4$
- b. $\text{Ca}_3(\text{PO}_4)_2$
- c. AlPO_4
- d. Ag_3PO_4
- e. $\text{Mg}_3(\text{PO}_4)_2$

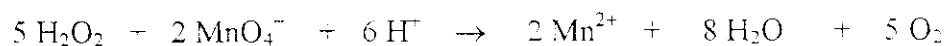
- Which is the chemical formula of the salt produced by neutralization of nitric acid with $\text{Ca}(\text{OH})_2$?

- a. CaNO_3
- b. $\text{Ca}_2(\text{NO}_3)_3$
- c. $\text{Ca}_3(\text{NO}_3)_2$
- d. Ca_2NO_3
- e. $\text{Ca}(\text{NO}_3)_2$

- What is the oxidation number of the element oxygen in the molecule OF_2 ?

- a. -2
- b. -1
- c. -1/2
- / d. +2
- e. -1
- f. +1/2

- In the following reaction the oxidizing agent is:



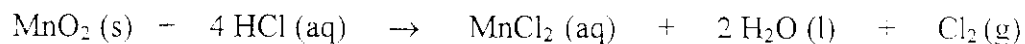
- a. H_2O_2
- b. MnO_4^-
- c. H^+
- d. Mn^{2+}
- e. O_2

- Which of the following gases will have the greatest density when they are all compared at the same temperature and pressure?
 - H₂
 - CClF₃
 - CO₂
 - C₂H₆
 - CF₄

- 2.0 moles of chlorine gas at 20.0° C are heated to 350 °C while the volume is kept constant. The density of the gas
 - increases
 - decreases
 - remains the same
 - not enough information given to correctly answer the question

- A sample of carbon monoxide gas collected in a 2.0 L flask by displacing water at 28 °C and 810 mm Hg. Calculate the number of CO molecules in the flask. The vapor pressure of water at 28 °C is 28.3 mm Hg.
 - 5.0×10^{22} molecules
 - 5.2×10^{22} molecules
 - 3.8×10^{23} molecules
 - 5.4×10^{23} molecules
 - 3.8×10^{25} molecules

- How many liters of chlorine gas at 650 mm Hg and 25 °C can be produced by the reaction of 2.0 L of 2.5 M HCl solution with excess MnO₂?



- 1.25 L
 - 24.2 L
 - 35.7 L
 - 88.6 L
 - 143 L
-
- Which statement is false?
 - The average kinetic energies of molecules from samples of different ideal gases is the same at the same temperature.
 - The molecules of an ideal gas are relatively far apart.
 - All molecules of an ideal gas have the same kinetic energy at constant temperature.
 - Molecules of a gas undergo many collisions with each other and the container walls.
 - Molecules of greater mass have a lower average speed than those of less mass at the same temperature.

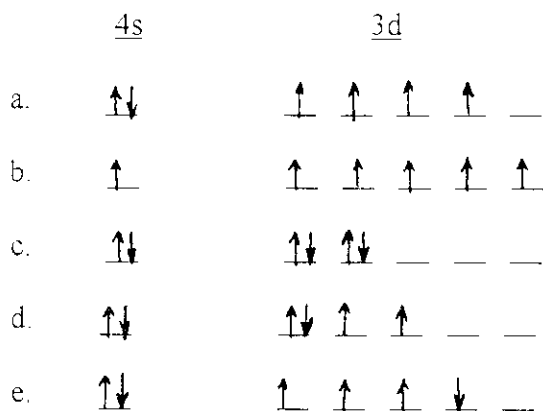
- Calculate the frequency of the light emitted by a hydrogen atom during a transition from the $n=6$ to the $n=3$ principal energy level.

- $1.64 \times 10^{15} \text{ s}^{-1}$
- $9.13 \times 10^{13} \text{ s}^{-1}$
- $3.65 \times 10^{14} \text{ s}^{-1}$
- $1.82 \times 10^{-19} \text{ s}^{-1}$
- $2.70 \times 10^{14} \text{ s}^{-1}$

- What is the maximum number of electrons that can have $n = 4$ and $m_s = +1/2$?

- 32 electrons
- 16 electrons
- 8 electrons
- 4 electrons
- 2 electrons

- The orbital diagram for a ground state Cr atom is



- The electron configuration of a copper atom (in the ground state) is:

- $[\text{Ar}]4s^24d^1$
- $[\text{Ar}]4s^24p^63d^3$
- $[\text{Ar}]4s^24d^7$
- $[\text{Ar}]3d^9$
- $[\text{Ar}]4s^14d^{10}$

- The maximum number of orbitals in a given energy level n is:

- $n-1$
- $2n+1$
- $2(n-1)+1$
- n^2
- $n(2n-1)$

